Evaluating Urban Planning: Evidence from Dar es Salaam

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Urban Planning

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  - Public use (esp. roads) 40-50% of developed land; private land zoned or regulated
- Developing country cities: planning often absent or ineffective
  - Informality may lower private investments and tax bases and worsen disamenities
  - Large cities, where growing share of humanity lives, face proliferation of slums

‘De novo’ Urban Planning in Developing Countries

- ‘De novo’ urban planning is important policy tool to address informality problem
  - Purchase cheap (greenfields) agricultural land on urban fringe
  - Partition into formal plots with minimal services - mostly unpaved roads
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- But scant evidence on effects of how de-novo neighborhoods are laid out

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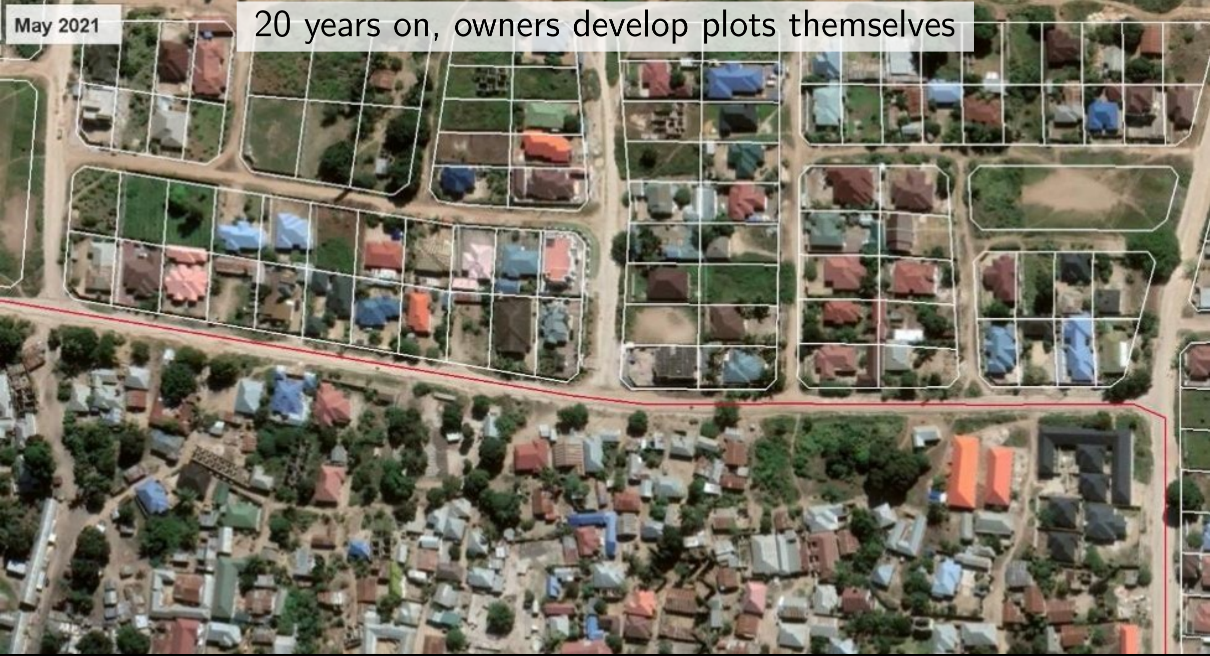
- Research designs: within neighbourhood variation; spatial regression discontinuity

Greenfield Site

Greenfield Site, land is parcelled and sold

20 years on, owners develop plots themselves



Main findings (∼10-20 years after project implementation)

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3. The owners, especially of large plots, are highly educated (poor mostly excluded)

Ancient history of urban planning

- Some urban gridding in Indus Valley, Mesopotamia, Assyria, and Egypt
- Greek towns initially developed organically
- But ∼ 479 BCE: Miletus planned (Paden 2001)
  - Two sizes of grids
  - Two agoras (public spaces)
  - Spaces for public buildings
- Gridded cities spread around ancient world via Alexander the Great & Roman Empire

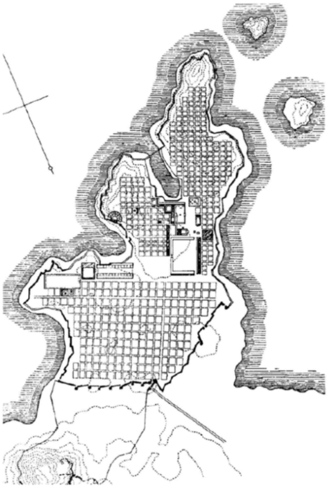
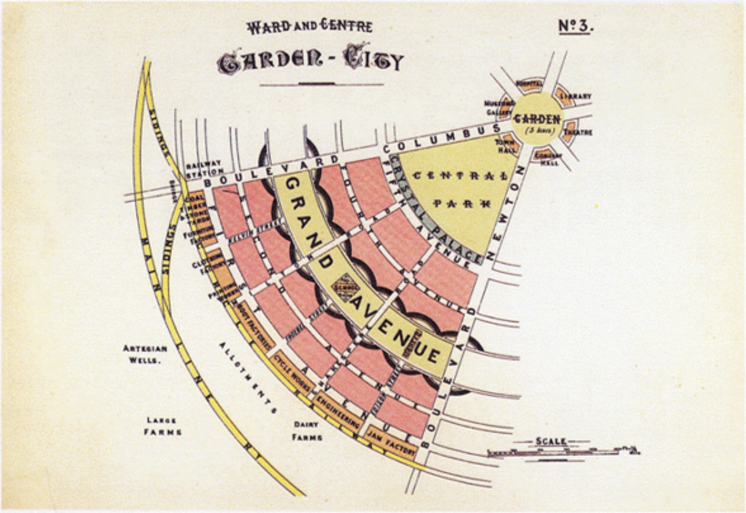


Figure 1. *Miletus.*[21]

"Garden Cities of To-Morrow" heavily influenced suburban planning
(Ebenezer Howard 1902)



- Exclusionary zoning is common (e.g., in US cities)
- Hundreds of graduate urban planning programs worldwide (QS ranking)
- But very little systematic evaluation of de novo urban planning

The economic problem: planners and markets

- Tradition of criticizing planners for ignoring individual agency
  - Adam Smith: “man of system” organizes lives as “pieces upon a chess board”
  - Jane Jacobs: critiques strict urban planning of Le Corbusier and Robert Moses

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- Some early recognition by economists that planning is key to city development
  - Zoning mitigates externalities (Davis and Whinston 1962, 1964)
  - Roads reduce congestion (Solow and Vickrey 1971, Dixit 1973)

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  - Zoning mitigates externalities (Davis and Whinston 1962, 1964)
  - Roads reduce congestion (Solow and Vickrey 1971, Dixit 1973)
- Urban planners & economists should communicate more (Bertaud 2018, Duranton 2017)
  - Market-based development - reflects people's preferences and information
  - Planning – property rights, public goods, externalities, coordination, distribution

Related Literature

- Land-use regulation and land markets
  (Turner et al. 2014 general restrictions; Kulka 2019, Kulka et al. 2022 density; Shertzer et al 2018 zoning; Gyourko & Molloy 2015 review)
  - We look at plot size and configuration explicitly, designated on greenfield land
- Urban housing policy in developing countries
  (Angel 2012, Romer 2012 urban expansion; Harari & Wong 2021 slum upgrading; Franklin 2020 housing estates; Owens et al. 2018 'Sites')
  - We study the impacts of ex-ante planning on greenfield, within minimal investment
- Colonial origins of institutions (e.g., Acemoglu et al. 2001, Baruah et al. 2021)
  - We study impact of planning regulations, which originated from British colonial rules
- Value of formal planned areas with property rights protection
  (De Soto 1989 property rights, Liebcap & Lueck 2011 orthogonal demarcation, Michaels et al. 2021 planning bundle)
  - We look within formal areas – study consequences of specific planning decisions
- Valuation of local amenities with sorting
  (e.g., Epple and Sieg 1999, Bayer, Ferreira and McMillan 2007)
  - We study planned amenities of different types and shed light on sorting

Context: the “20,000 Plot” project in Tanzania

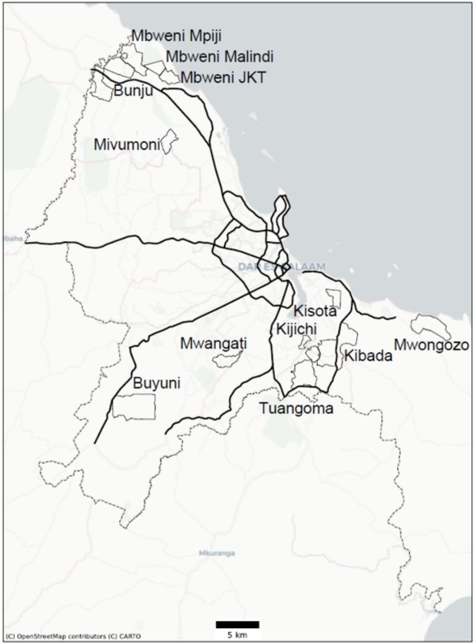
- Project implemented circa 2000-2010, ‘de novo’ (empty greenfield)
  - Initiated in response to perceived demand for formal plots in late 1990s
- Initial plan for around 20,000 plots in Dar es Salaam and other cities
  - We refer to it informally as “20k plots” or “20k” for short
- Eventually, 12 program areas in Dar es Salaam with ∼36,000 residential plots
  - This is the focus area of our study
  - We ignore a few thousand additional plots in other cities in Tanzania (no data)

Locations of 20k areas in Dar es Salaam.

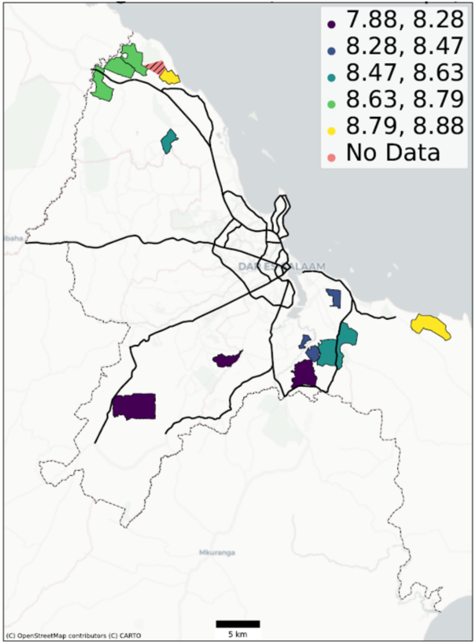
Bold lines: preexisting.

main paved roads

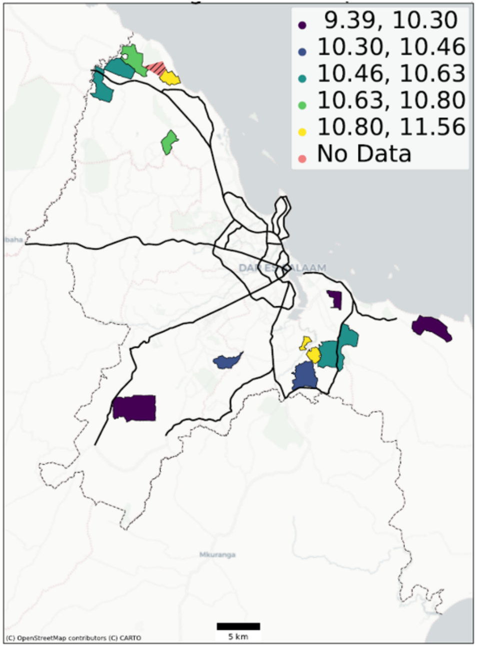
Dashed lines: city edge.



Initial log land prices set by government circa 2001 to cover costs



Log land prices rose steeply everywhere, but heterogeneously



Project specifications

- 20k plot project provided:
  - Residential plots (planned, surveyed, and titled) sized from 400-4000 sqm
  - Non-residential plots where public and commercial services could be provided
    - In practice there was very little gov't provision of services or utilities
  - Roads of different widths, mostly unpaved and without roadside ditches

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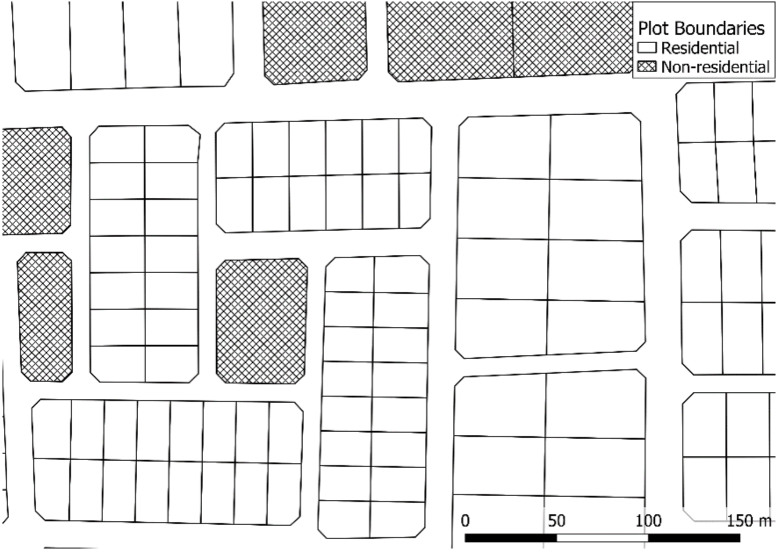
- Although government sale price (mean $\sim$1 USD in 2021 prices per sqm) was affordable, it was difficult for poor people to purchase plots because:
  - Minimum plot size, which under British rule facilitated segregation, was large
    - Retained after independence, only recently reduced to 300 sqm (Kironde 2006)
  - Process of plot sale was rushed to repay internal gov't loan

Example: plots of different sizes in Tuangoma



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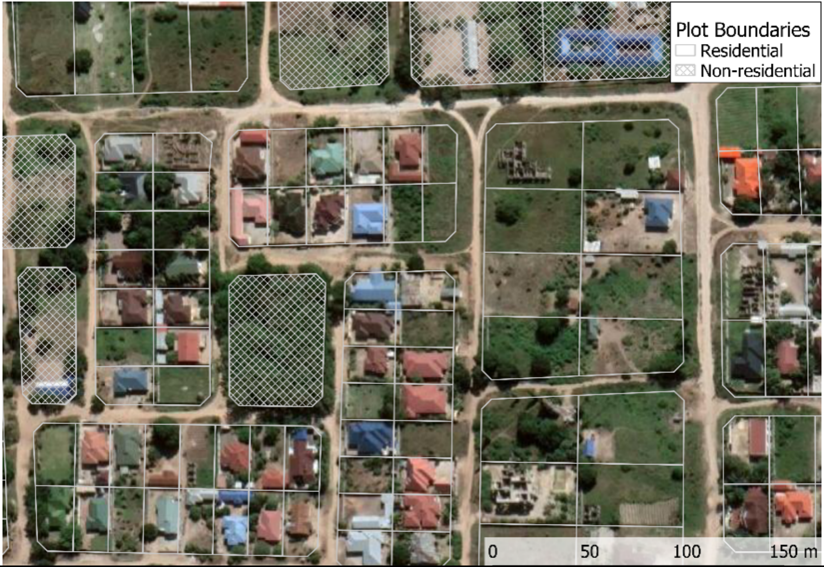
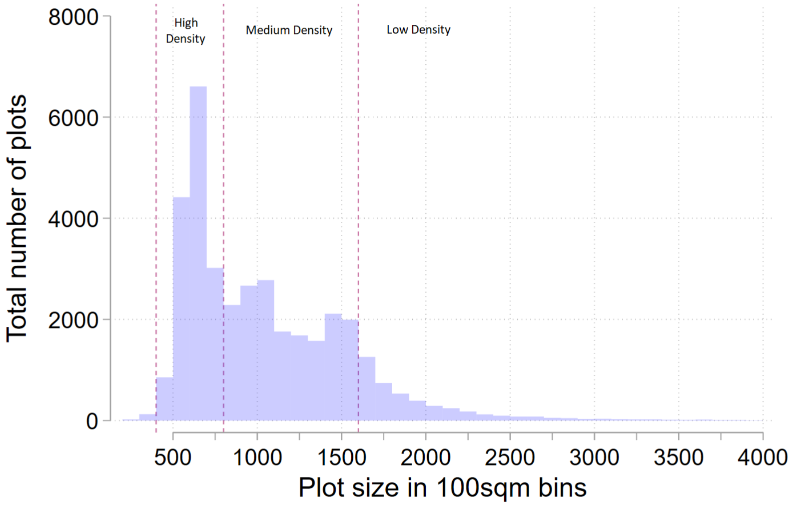


Distribution of planned plot sizes



Planned non-residential use and road reserves in Mwbeni Mpiji

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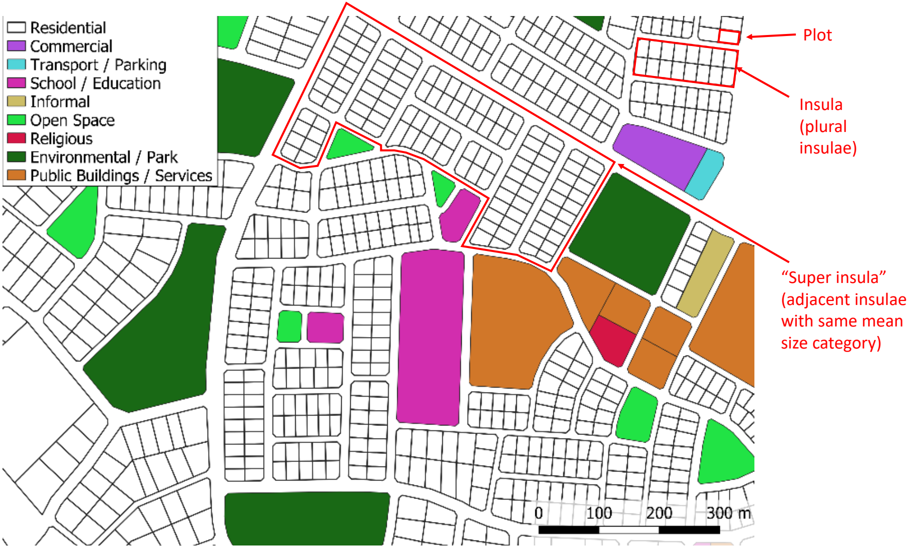


Planned non-residential use and road reserves in Mwbeni Mpiji

What we examine using a model

- What types of people end up buying the limited supply of plots in 20k areas
  - Who buys plots with different sizes and amenities
- How plot sizes and amenities affect land prices, capital investment, and timing of construction (we observe whether plot is built in cross-section)

Model assumptions on preferences

- Residents live in city (center). At time 0 (early 2000s, after gov't sale) they can buy a 20k plot and move there at time τ and build a house using land and capital
- Utility in city at time t (h_1 city housing, z_1 city consumption, A city amenity):

$$u_1(t) = \varphi ln h_1 + \beta ln z_1 + Ae^{-\theta t}$$

- Utility in 20K suburbs (l plot size, k capital, z_2 other consumption):

$$u_2(t) = \varphi ln(l^\alpha k^{1-\alpha}) + \beta ln z_2 + B$$

where $\varphi, \beta < 1$ and $A, B, \theta > 0$ and $B < A$

  - City amenity deteriorates at a rate $\frac{du_1}{dt}/u_1 = -\theta$ relative to 20k (congestion)

Objective function

People maximise lifetime utility subject to a budget constraint

$$\max_{h_1,z_1,k,z_2,\tau} \int_0^\tau [\varphi ln h_1 + \beta ln z_1 + Ae^{-\theta t}]e^{-\rho t}dt + \int_\tau^\infty [\varphi ln(l^\alpha k^{1-\alpha}) + \beta ln z_2 + B]e^{-\rho t}dt$$
$$+ \omega \left(\int_0^\infty we^{-\delta t}dt - \int_0^\tau (ph_1 + z_1)e^{-\delta t}dt - \int_\tau^\infty z_2 e^{-\delta t}dt - rke^{-\delta\tau} - R(B,l) \right)$$

where:

- p is rental price (or opportunity cost) of housing in city
- w is annual income of resident (can be any income stream)
- r is price of capital (ignore capital market imperfections for the well-off)
- $R(B,l)$ is price of a 20K plot of type (B,l) at time 0

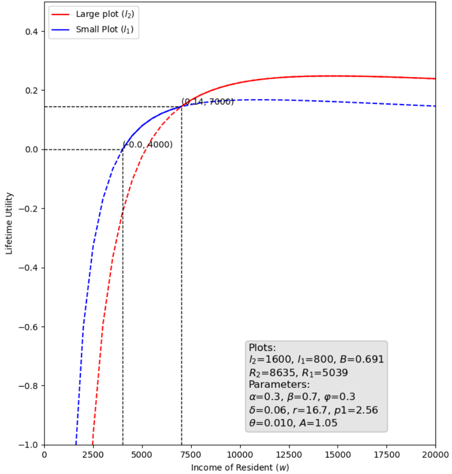
Optimization, comparative statics, parameterization

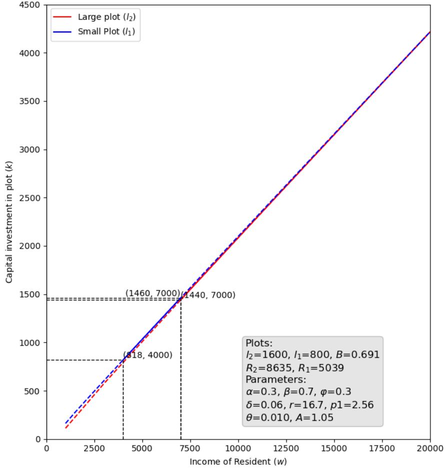
- Assume $\rho = \delta$ so z constant over time
- Use first order conditions to characterize comparative statics on τ and k, *holding income constant*, but we have limited data on income
- Equilibrium cannot be solved in closed form
- Take parameters from literature where possible (list in a subsequent slide)
- Calibrate A to fit typical plot sizes, prices, and time of exit.

Example 1: Nash equilibrium with 2 plot sizes and a range of incomes

- Assume N plots in total: N_1 are small (800 sq m) and N_2 large (1600 sq m)
  - Generalizes to many (countable number) of plots of different sizes
- Assume incomes are between 1 and 21000
- In equilibrium plots go to highest income people
- We assume that income distribution is such that:
  - The N people who buy in 20k plots have incomes 4000 to 21000
    - Person with 4000 indifferent between moving and staying in city (rest get surplus)
  - Those with incomes above $w(N_2) = 7000$ buy large plots (the rest buy small)
    - Person with 7000 indifferent between the two plot sizes

Example 1: Plot lifetime utilities (net of city utility) and k





$\tau = 9.5$ at $w = 4000$. τ rises to 15.1 as w approaches 7000 (rich can consume more housing in city, whereas formal 20k land rationed). τ falls to 8.3 on switch to larger plots

Example 1: Oversupply of large plots in equilibrium

- With marginal consumer of large plots at $w = 7000$, price per square meter on a small plot (6.3) greater than a large plot (5.4)
- To equalize price per sq m, supply more small plots and fewer large plots
  - Or equivalently, increase marginal consumer's income to 20,000

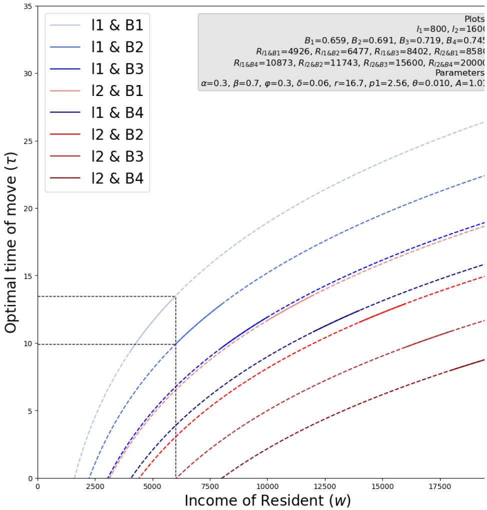
Example 2: Differential amenities (B)

Now assume each plot size (small and large) has four types: $B_4 > B_3 > B_2 > B_1$
Assume that differences in amenities (Bs) are small relative to plot size diffs

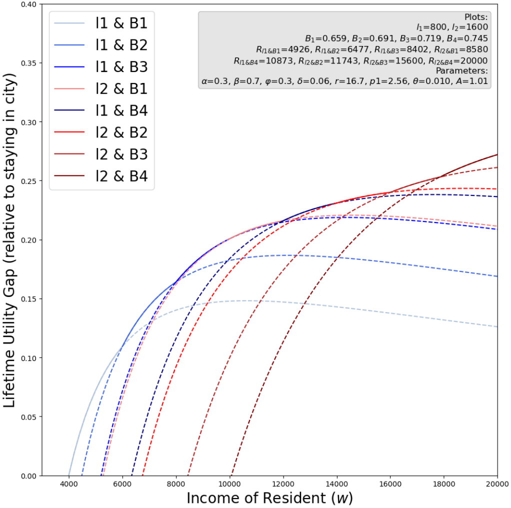
- In equilibrium, plot prices increase in B within plot size category
- For same plot size, higher B plots go to the richer people
- Given prices, marginal consumers indifferent between their plot and next higher B
- As B jumps up:
  - τ drops, so people leave center city earlier (plots likelier to be built)
  - k declines slightly (with the price increase).

Example 2: Differential B's (Switch point to large plots now 12000)

Optimal τ in equilibrium



Plot of lifetime utilities



Taking model predictions to the data

- **Rich people sort into 20k** (lifetime earnings proxied by education)
  - Within 20k **richer owners sort into larger plots**
- Plot size (l)
  - **Increases plot price** but may **reduce price per sq m** (if large plots oversupplied)
  - Conditional on income, decreases k and increases build rate (inverse of τ)
    - But large plots attract richer people, which increases k and *decreases* build rate
    - In city (not in 20k) land is optimized - in simulations this matters more for rich, who stay long in city. So unconditional effect of l on k and build rate ambiguous
- Amenities (e.g., proximity to main paved road)
  - **Increase total plot price and price per square meter**
  - Have ambiguous effect on on k and build rate (similar to plot size)

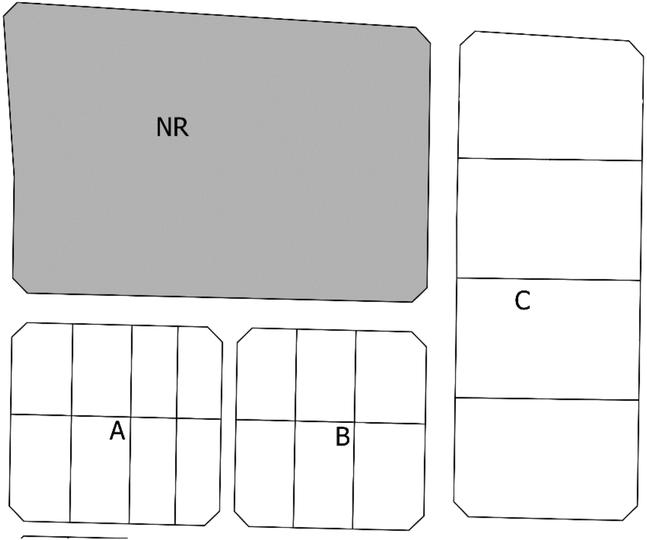
Data Sources

- Data on planning treatments from three Tanzanian gov't sources:
  - Survey Maps, Town Planning Drawings and Cadaster data
- Questionnaires we administered:
  - Local real estate agents (dalali) for plot transactions prices
  - Residents (∼3,200 households) - augment prices, educational attainment
  - Local (mitaa) leaders
  - Enumeration of non-residential plots and public transport access
- Very high-resolution satellite imagery
  - From 2019-2021 (and going back to 2000) - traced building outlines (and more)
- Others: Historical paved main roads, Digital elevation map, OpenStreetMap

Dataset construction

- We classify **residential plots** as those which:
  - Are not designated for non-residential use
  - And have an area of no more than 4,000sqm (formal maximum)
- We define 20m x 20m **gridcells (observations)**
  - Corresponds to size of minimum formal plot (400sqm)
  - Focus on cells whose centroid is within residential plot
  - Each gridcell can be **treated** by planners (e.g., assigned to small vs. large plot)
- Twelve 20k areas in Dar es Salaam (total of ∼75sqkm)
  - About half of area (38sqkm) taken up by ∼95,000 residential gridcells
  - Other half: non-residential plots, roads, and hazardous areas (e.g., streams)

Dataset construction

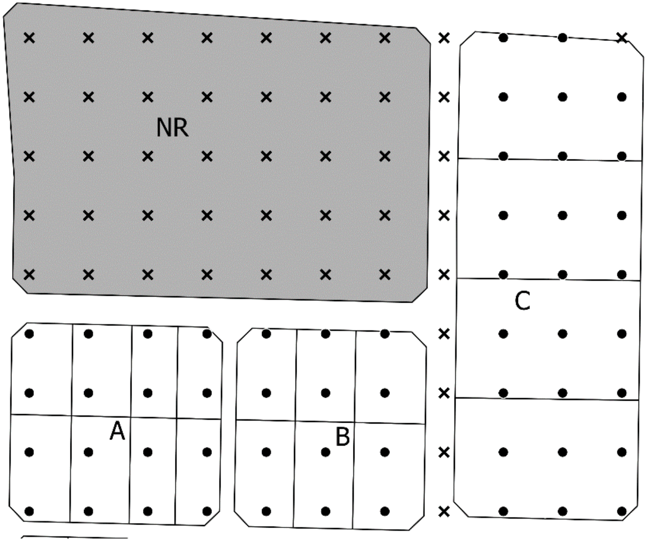


Plots as defined in the survey plans

Residential (white), and non-residential (“NR” grey) insulae

Each residential insula given unique ID (A, B, C)

Dataset construction

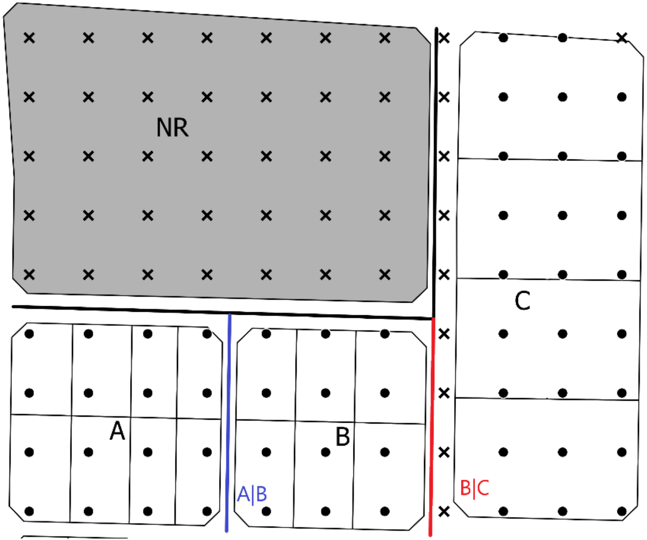


Gridcell ("cells") centroids spaced 20m apart

Take cells with centroids that fall in plots (dots)

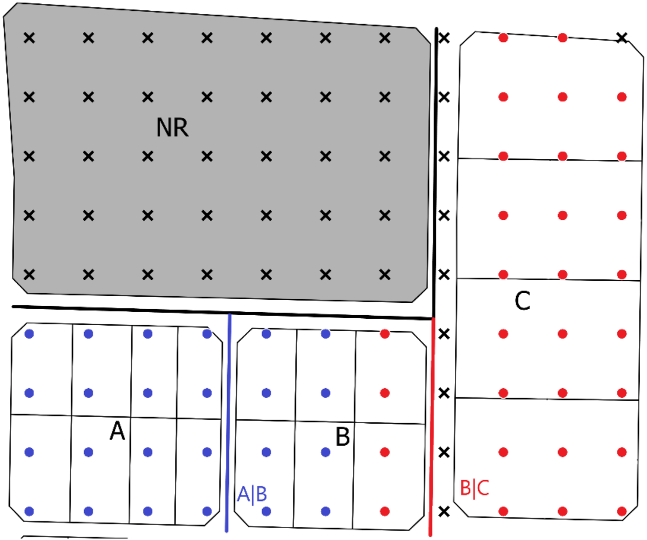
Ignore cells that fall between ('x's)

Dataset construction



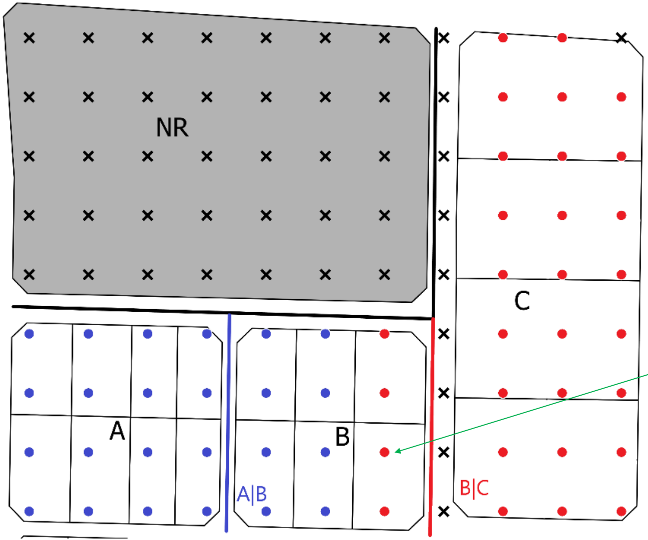
- Boundaries fall equidistant between insulae
- Use residential-residential boundaries (blue and red)
- Ignore non-residential boundaries (black)

Dataset construction



- Assign grid squares based on the boundary that that are nearest to (blue and red)

Dataset construction



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This gridcell is on small side of B-C boundary segment, since insula B has smaller mean plot size

Methodology overview

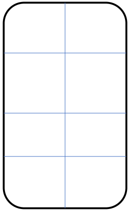
- OLS using variation in planning variables within 20k areas
- Semi-parametric RD for estimating effects of plot size
  - Restrict to 100m from insulae boundary, linear distance controls on both sides
  - For RD regressions we use mean plot size of gridcell's insula's
- Inference: cluster s.e. by insula (main units of plot size assignment)
- Outcomes: price (∼3% of plots), quantity (proxy build rate and k for all plots)
  - Ln market transaction price of plots sold as bare land
  - Share gridcell built; Plot built; Ln(sum footprints up to 3 largest plot buildings); Multiple buildings indicator (backyarding)

Methodology overview (continued)

- Controls:
  - (F.e. for 20k project areas) X (F.e. for mitaa, which are small admin areas)
  - For price regs: (F.e. time period of sale) X (Source: Real estate agents, Residents)
- Amenities (including disamenities):
  - Elevation, ruggedness, indicators for within 100m of river/stream or water/wetland
  - Indicator for gridcell within 100m of planned amenities
    - Open space, nursery school, religious site, education (primary or secondary school), service trade, housing estate, public buildings, cemetery, other
  - Distance to preexisting paved main road
  - Insula Regularity Z-index

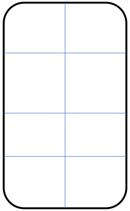
Insula Regularity Z-index combines three measures

Insula Homogeneity:
1 - coefficient of variation
of plot sizes within insula

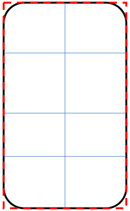


Insula Regularity Z-index combines three measures

Insula Homogeneity:
1 - coefficient of variation of plot sizes within insula



Insula Rectangularity:
(Size of insula) / (Size of minimal containing rectangle)

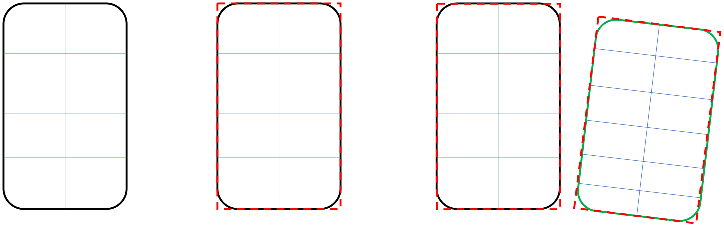


Insula Regularity Z-index combines three measures

Insula Homogeneity:
1 - coefficient of variation of plot sizes within insula

Insula Rectangularity:
(Size of insula) / (Size of minimal containing rectangle)

Insula Alignment: 1 - difference in alignment of insula's minimal containing rectangle (modulo 90 degrees) and alignment of nearest insula's containing rectangle



Empirical Results Overview

1. Descriptive: price appreciation in 20k areas
2. Residential plots
   a) Own plot size effect on land prices
   b) Own plot size effect on housing outcomes
   c) Neighbouring plot effects
3. Natural and planned amenities (and implementation rates)
4. Sorting (into 20k areas, between 20k areas, and within them)

Descriptive: price appreciation in 20k areas

- Initial plots all sold in early 2000s Plot acquisition process
  - Yet, only ∼50% of plots built upon by 2020
- Large price increases in every area
  - ∼Sixfold mean real appreciation of prices compared to gov't sale price

Descriptive: price in and outside of 20K areas (dalali data only)

$$\text{ln price}_{p(i),t(p)} = \beta \text{ ln size}_{p(i)} + \gamma \text{Non20kS}_{p(i)} + \delta \text{Non20kU}_{p(i)} + \eta_{t(p)} + \mu_{l(i)} + \varepsilon_i$$

Note: gridcell i falls in plot p sold at time period $t(p)$ in neighborhood location $l(i)$

Descriptive: price in and outside of 20K areas (dalali data only)

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Note: gridcell i falls in plot p sold at time period $t(p)$ in neighborhood location $l(i)$

	(1) Ln Price	(2) Ln Price
Ln plot size	0.71	0.69
	(0.054)	(0.041)
Non-20K Surveyed	-0.23	-0.27
	(0.16)	(0.12)
Non-20K Unsurveyed	-0.70	-0.71
	(0.099)	(0.079)
Mean Outcome	17	17
20K or Nearest FE		✓
N	2074	2074

- Land prices in 20k roughly twice in non-20k unsurveyed
- Broadly consistent with interviews of local leaders
- Non-20k surveyed are rare

Descriptive evidence on price mechanisms from Leader interviews

- We surveyed Mtaa leaders intersecting 20k areas. Key question:
  - *What factors or characteristics do you think determine the difference in the price of land in 20k versus non-20k areas?*
- 31 (of 34) leaders answered this question:
  - 24 mentioned property rights
    - Reasons mentioned: reductions in boundary conflicts, increased tenure security, access to financial credit (titles can serve as collateral)
  - 23 mentioned access
    - Non-20k areas tend to clog up
  - Other explanations much less common

Own plot size effect on **land price** (OLS, dalali + household data)

$$\ln \text{price}_{p(i)} = \beta \ln \text{size}_{p(i)} + \eta_{t(p)} + \mu_{l(i)} + \varepsilon_i$$

Own plot size effect on **land price** (OLS, dalali + household data)

$$\text{ln price}_{p(i)} = \beta \text{ ln size}_{p(i)} + \eta_{t(p)} + \mu_{l(i)} + \varepsilon_i$$

	(1)	(2)	(3)
Panel A: Ln plot price			
Ln plot size	0.55	0.46	0.49
	(0.071)	(0.053)	(0.060)
Mean Outcome	17	17	17
20k*MTAA FE		✓	✓
Amenities			✓
N (gridcells)	4074	4074	4074
N (plots)	1446	1446	1446

Own plot size effect on **land price** (OLS, dalali + household data)

$$\ln \text{price}_{p(i)} = \beta \ln \text{size}_{p(i)} + \eta_{t(p)} + \mu_{l(i)} + \varepsilon_i$$

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20k*MTAA FE		✓	✓
Amenities			✓
N (gridcells)	4074	4074	4074
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- Bigger plots sell at a unit price discount on land
  - Suggests misallocation

Own plot size effect on **land price** (OLS, dalali + household data)

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N (gridcells)	4074	4074	4074
N (plots)	1446	1446	1446

- Bigger plots sell at a unit price discount on land
  - Suggests misallocation
- Results similar using:
  - Plot-level regressions
  - 2SLS using dalali estimates of ln plot size to address measurement error

Own plot size effect on land price/sqm (OLS)

$$\ln(\text{price/sqm})_{p(i)} = \beta \ln \text{size}_{p(i)} + \eta_{t(p)} + \mu_{l(i)} + \varepsilon_i$$

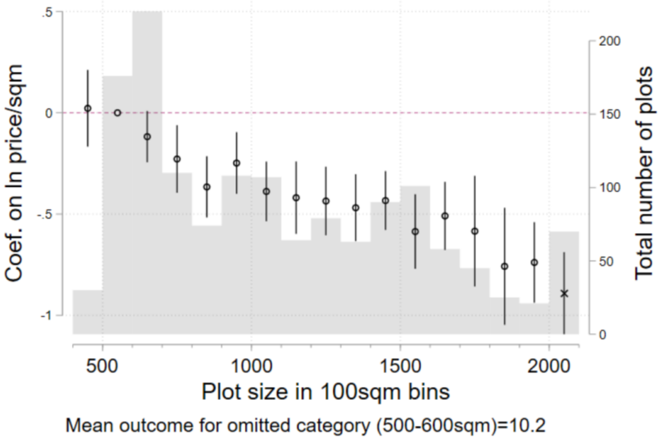
Ln plot size	-0.54	-0.51		
	(0.053)	(0.060)		
Medium			-0.33	-0.28
			(0.043)	(0.045)
Large			-0.61	-0.56
			(0.063)	(0.066)
Mean Outcome	10	10	10	10
20k*MTAA FE	✓	✓	✓	✓
Amenities		✓		✓
N (gridcells)	4074	4074	4074	4074
N (plots)	1446	1446	1446	1446

Own plot size effect on land price/sqm (OLS, bins)

$$\text{ln(price/sqm)}_{p(i)} = \sum_b \beta_b I(\text{size}_{p(i)} \in b) + \eta_{t(p)} + \mu_{l(i)} + \varepsilon_i$$

Own plot size effect on land price/sqm (OLS, bins)

$$\ln(\text{price/sqm})_{p(i)} = \sum_b \beta_b I(\text{size}_{p(i)} \in b) + \eta_{t(p)} + \mu_{l(i)} + \varepsilon_i$$



Own plot size effect on land price/sqm (Spatial RD)

$$\ln \text{price/sqm}_{p(i)} = \beta \text{larger}_{I(i)} + \delta_0 \text{dist}_i * \text{larger}_{I(i)} + \delta_1 \text{dist}_i * \text{smaller}_{I(i)} + \eta_{t(p)} + \mu_{l(i)} + \varepsilon_i$$

Note: gridcell i belongs to insula I which is paired with i's nearest other insula.

Own plot size effect on land price/sqm (Spatial RD)

$$\text{ln price/sqm}_{p(i)} = \beta \text{larger}_{I(i)} + \delta_0 \text{dist}_i * \text{larger}_{I(i)} + \delta_1 \text{dist}_i * \text{smaller}_{I(i)} + \eta_{t(p)} + \mu_{l(i)} + \varepsilon_i$$

Note: gridcell i belongs to insula I which is paired with i's nearest other insula.

Panel A: all insula pairs

Own Larger	-0.17
	(0.055)
Mean Outcome	9.9
N (gridcells)	3511
N (plots)	1228

Panel B: gap≥400sqm

Own Larger	-0.45
	(0.14)
Mean Outcome	9.8
N (gridcells)	1003
N (plots)	335

Panel C: gap<100sqm

Own Larger	-0.097
	(0.066)
Mean Outcome	10
N (gridcells)	1016
N (plots)	472

Back of the envelope: net gains from splitting large plots

- Could splitting (marginal) large plot in initial plan have increased current value?
  - At planning phase, average cost per plot : <US$157
    - e.g. surveying, road construction, valuation, etc
  - Take one 1600 sqm plot: worth US$16.7k in 2021
  - Split it into four 400 sqm plots, each worth: US$6.3k in 2021
  - Assume splitting involves mean cost of plot creation (conservative)
  - **Net gain: US$8k, or ∼50%**
    - $8000 \sim 6300 * 4 - 16700 - (4 - 1) * 157$
- Even if some further cost of allocating more land to roads, gain still substantial
- But nowadays splitting plots is difficult (legal and procedural barriers)

Own plot size effect on **housing outcomes** (OLS)

	Share gridcell built	Plot is built	Log area of buildings	Multiple buildings on plot
Panel A: 20k*MTAA FE controls				
Ln plot size	-0.087	-0.031	0.11	0.18
	(0.0025)	(0.0091)	(0.017)	(0.011)
Mean Outcome	0.11	0.49	5.3	0.38
N (gridcells)	94789	94789	46465	46465
N (plots)	36215	36215	17822	17822
Panel B: 20k*MTAA FE + Amenity controls				
Ln plot size	-0.078	-0.00040	0.14	0.19
	(0.0026)	(0.0094)	(0.018)	(0.012)
Mean Outcome	0.11	0.49	5.3	0.38
N (gridcells)	94789	94789	46465	46465
N (plots)	36215	36215	17822	17822

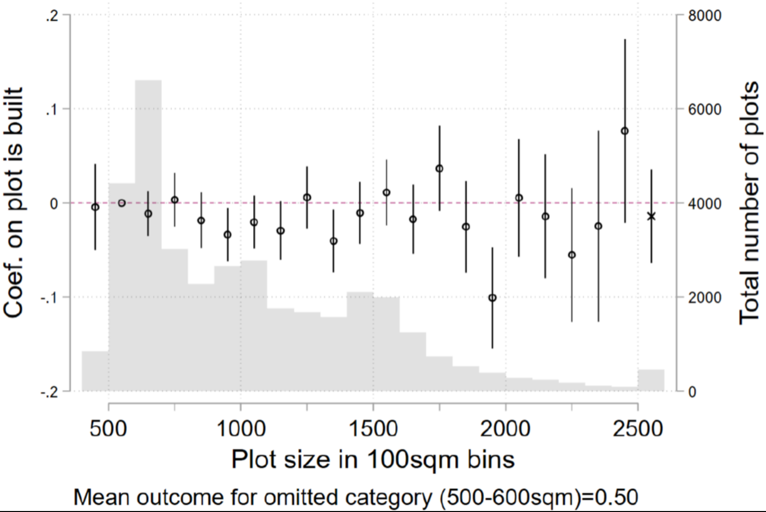
Own plot size effect on **Plot Built** (OLS, bins)

$$\text{Plot is Built}_{p(i)} = \sum_b \beta_b I(\text{size}_{p(i)} \in b) + \mu_{l(i)} + \varepsilon_i$$

Own plot size effect on **Plot Built** (OLS, bins)

$$\text{Plot is Built}_{p(i)} = \sum_b \beta_b I(\text{size}_{p(i)} \in b) + \mu_{l(i)} + \varepsilon_i$$

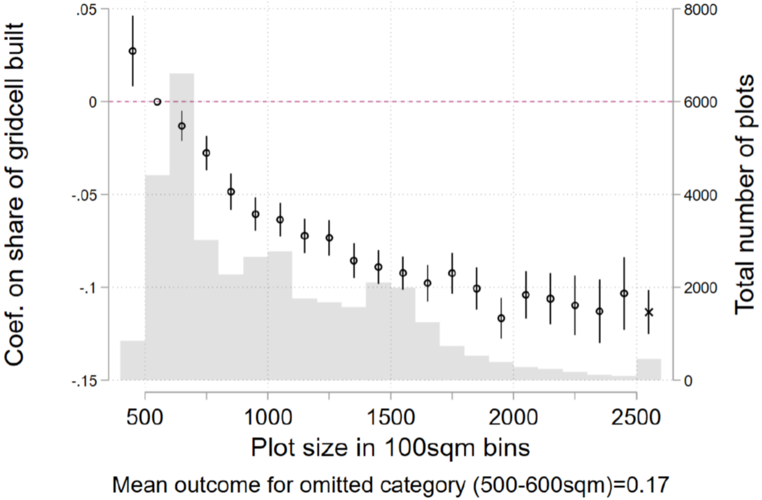
Larger plots (perhaps) less likely to be built upon



Own plot size effect on **Share Gridcell Built** (OLS, bins)

$$\text{Share Built}_i = \sum_b \beta_b I(\text{size}_{p(i)} \in b) + \mu_{l(i)} + \varepsilon_i$$

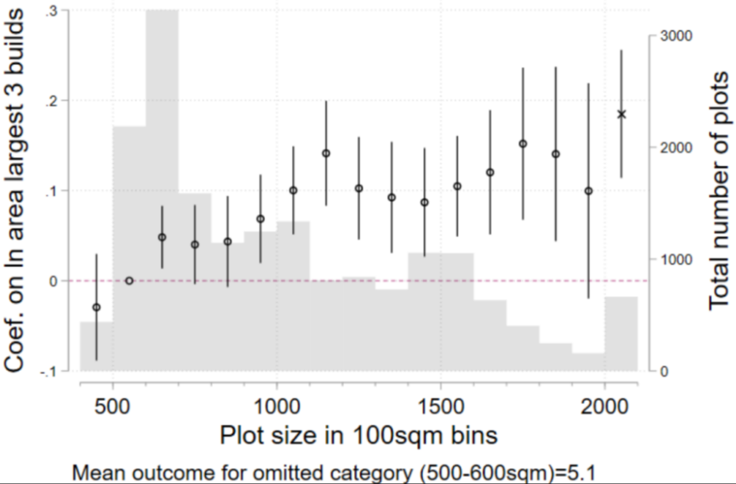
larger plots have more outdoor space (wasted vs preference)



Own plot size effect on **Log size 3 largest buildings** (OLS, bins)

$$\text{Build Size}_{p(i)} = \sum_b \beta_b I(\text{size}_{p(i)} \in b) + \mu_{l(i)} + \varepsilon_i$$

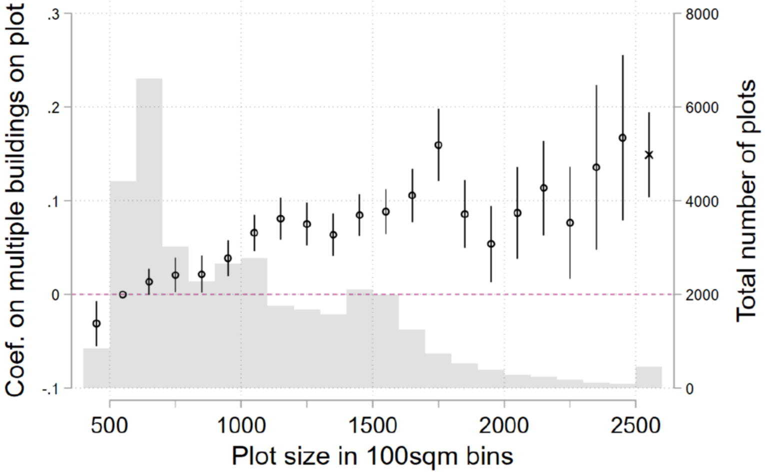
Ln total footprint of up to three largest buildings on plot increases with plot size



Own plot size effect on **Multiple Buildings** (OLS, bins)

$$\text{Multi Builds}_{p(i)} = \sum_b \beta_b I(\text{size}_{p(i)} \in b) + \mu_{l(i)} + \varepsilon_i$$

Share of plots with multiple buildings increases in plot size (backyarding vs out-buildings)



Mean outcome for omitted category (500-600sqm)=0.11

Own plot size effects on housing outcomes (Spatial RD)

	(1) Ln Price per sqm	(2) Share gridcell built	(3) Plot is built	(4) Log area of buildings	(5) Multiple buildings on plot
Panel A: all insula pairs					
Own Larger	-0.17	-0.017	0.011	-0.018	0.026
	(0.055)	(0.0025)	(0.0080)	(0.018)	(0.013)
Mean Outcome	9.9	0.11	0.49	5.2	0.39
N (gridcells)	3511	87569	87569	42715	42715
N (plots)	1228	33613	33613	16474	16474
Panel B: gap≥400sqm					
Own Larger	-0.45	-0.036	0.0082	-0.0078	0.080
	(0.14)	(0.0050)	(0.016)	(0.042)	(0.030)
Mean Outcome	9.8	0.093	0.47	5.3	0.41
N (gridcells)	1003	22483	22483	10526	10526
N (plots)	335	9066	9066	4219	4219
Panel C: gap<100sqm					
Own Larger	-0.097	-0.0094	-0.0030	-0.011	-0.015
	(0.066)	(0.0042)	(0.013)	(0.027)	(0.019)
Mean Outcome	10	0.12	0.50	5.2	0.36
N (gridcells)	1016	30460	30460	15079	15079
N (plots)	472	15157	15157	7469	7469

Own plot size effects (Interacted RD magnitudes similar to OLS)

	(1) Ln Price per sqm	(2) Share gridcell built	(3) Plot is built	(4) Log area of buildings	(5) Multiple buildings on plot
Panel A: RD across insulae with interaction for log mean difference					
Own Larger $\times\Delta$ ln mean size	-0.50	-0.078	-0.025	0.13	0.23
	(0.28)	(0.0052)	(0.017)	(0.046)	(0.029)
Own Larger	-0.073	0.0013	0.017	-0.046	-0.023
	(0.070)	(0.0027)	(0.0089)	(0.020)	(0.014)
Mean Outcome	9.9	0.11	0.49	5.2	0.39
N (gridcells)	3511	87569	87569	42715	42715
N (plots)	1228	33613	33613	16474	16474
Panel B: OLS with RD sample from panel A					
Ln plot size	-0.51	-0.082	-0.0081	0.12	0.19
	(0.057)	(0.0026)	(0.0094)	(0.019)	(0.012)
Mean Outcome	9.9	0.11	0.49	5.2	0.39
N (gridcells)	3511	87569	87569	42715	42715
N (plots)	1228	33613	33613	16474	16474

Neighbouring (super-insula) plot size effects (Spatial RD)

	(1) Share gridcell built	(2) Plot is built	(3) Log area of buildings	(4) Multiple buildings on plot
Own Larger	-0.0013	-0.00053	-0.0031	0.023
	(0.0026)	(0.011)	(0.021)	(0.015)
Own Smaller × Dist. (km)	0.053	0.21	-0.051	-0.010
	(0.017)	(0.066)	(0.12)	(0.083)
Own Larger × Dist. (km)	-0.029	0.030	0.094	-0.048
	(0.018)	(0.070)	(0.13)	(0.088)
Ln plot size	-0.066	0.026	0.18	0.21
	(0.0032)	(0.013)	(0.027)	(0.018)
Mean Outcome	0.11	0.49	5.3	0.38
N (gridcells)	92753	92753	45559	45559
N (plots)	35525	35525	17474	17474

Amenities part I: proximity to main roads prized (both p and q)

	Ln Price	Share gridcell built	Plot is built	Log area of buildings	Multiple buildings on plot
Ln plot size	0.49	-0.078	-0.00040	0.14	0.19
	(0.060)	(0.0026)	(0.0094)	(0.018)	(0.012)
Dist (km) paved major road	-0.15	-0.015	-0.041	-0.063	-0.040
	(0.031)	(0.0016)	(0.0071)	(0.012)	(0.0088)
Elevation (m)	0.0024	0.00089	0.0028	0.0031	0.00036
	(0.0024)	(0.000098)	(0.00043)	(0.00067)	(0.00049)
Ruggedness	-0.0089	-0.0058	-0.016	-0.011	-0.0095
	(0.022)	(0.00098)	(0.0039)	(0.0090)	(0.0052)
River/stream 100m	0.00060	-0.027	-0.11	-0.061	-0.040
	(0.17)	(0.0052)	(0.022)	(0.058)	(0.048)
Water/wetland 100m		0.0073	-0.070	-0.081	0.050
		(0.0088)	(0.031)	(0.16)	(0.22)
Z-index: 3 Ins. Characteristics	0.046	0.0031	0.017	0.0091	0.0075
	(0.027)	(0.0013)	(0.0058)	(0.010)	(0.0070)
20k edge in 100m	0.024	-0.0045	-0.012	-0.030	0.013
	(0.043)	(0.0023)	(0.0096)	(0.016)	(0.011)

Amenities part I: elevation valued (spurs development)

	Ln Price	Share gridcell built	Plot is built	Log area of buildings	Multiple buildings on plot
Ln plot size	0.49	-0.078	-0.00040	0.14	0.19
	(0.060)	(0.0026)	(0.0094)	(0.018)	(0.012)
Dist (km) paved major road	-0.15	-0.015	-0.041	-0.063	-0.040
	(0.031)	(0.0016)	(0.0071)	(0.012)	(0.0088)
Elevation (m)	0.0024	0.00089	0.0028	0.0031	0.00036
	(0.0024)	(0.000098)	(0.00043)	(0.00067)	(0.00049)
Ruggedness	-0.0089	-0.0058	-0.016	-0.011	-0.0095
	(0.022)	(0.00098)	(0.0039)	(0.0090)	(0.0052)
River/stream 100m	0.00060	-0.027	-0.11	-0.061	-0.040
	(0.17)	(0.0052)	(0.022)	(0.058)	(0.048)
Water/wetland 100m		0.0073	-0.070	-0.081	0.050
		(0.0088)	(0.031)	(0.16)	(0.22)
Z-index: 3 Ins. Characteristics	0.046	0.0031	0.017	0.0091	0.0075
	(0.027)	(0.0013)	(0.0058)	(0.010)	(0.0070)
20k edge in 100m	0.024	-0.0045	-0.012	-0.030	0.013
	(0.043)	(0.0023)	(0.0096)	(0.016)	(0.011)

Amenities part I: ruggedness, rivers/streams, water/wetlands avoided

	Ln Price	Share gridcell built	Plot is built	Log area of buildings	Multiple buildings on plot
Ln plot size	0.49	-0.078	-0.00040	0.14	0.19
	(0.060)	(0.0026)	(0.0094)	(0.018)	(0.012)
Dist (km) paved major road	-0.15	-0.015	-0.041	-0.063	-0.040
	(0.031)	(0.0016)	(0.0071)	(0.012)	(0.0088)
Elevation (m)	0.0024	0.00089	0.0028	0.0031	0.00036
	(0.0024)	(0.000098)	(0.00043)	(0.00067)	(0.00049)
Ruggedness	-0.0089	-0.0058	-0.016	-0.011	-0.0095
	(0.022)	(0.00098)	(0.0039)	(0.0090)	(0.0052)
River/stream 100m	0.00060	-0.027	-0.11	-0.061	-0.040
	(0.17)	(0.0052)	(0.022)	(0.058)	(0.048)
Water/wetland 100m		0.0073	-0.070	-0.081	0.050
		(0.0088)	(0.031)	(0.16)	(0.22)
Z-index: 3 Ins. Characteristics	0.046	0.0031	0.017	0.0091	0.0075
	(0.027)	(0.0013)	(0.0058)	(0.010)	(0.0070)
20k edge in 100m	0.024	-0.0045	-0.012	-0.030	0.013
	(0.043)	(0.0023)	(0.0096)	(0.016)	(0.011)

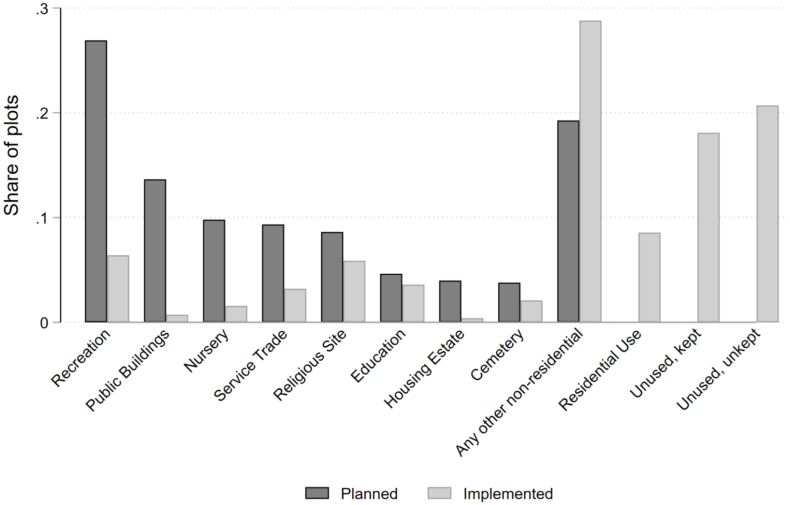
Amenities part I: Insula Regularity (rectangularity, alignment) valued

	Ln Price	Share gridcell built	Plot is built	Log area of buildings	Multiple buildings on plot
Ln plot size	0.49	-0.078	-0.00040	0.14	0.19
	(0.060)	(0.0026)	(0.0094)	(0.018)	(0.012)
Dist (km) paved major road	-0.15	-0.015	-0.041	-0.063	-0.040
	(0.031)	(0.0016)	(0.0071)	(0.012)	(0.0088)
Elevation (m)	0.0024	0.00089	0.0028	0.0031	0.00036
	(0.0024)	(0.000098)	(0.00043)	(0.00067)	(0.00049)
Ruggedness	-0.0089	-0.0058	-0.016	-0.011	-0.0095
	(0.022)	(0.00098)	(0.0039)	(0.0090)	(0.0052)
River/stream 100m	0.00060	-0.027	-0.11	-0.061	-0.040
	(0.17)	(0.0052)	(0.022)	(0.058)	(0.048)
Water/wetland 100m		0.0073	-0.070	-0.081	0.050
		(0.0088)	(0.031)	(0.16)	(0.22)
Z-index: 3 Ins. Characteristics	0.046	0.0031	0.017	0.0091	0.0075
	(0.027)	(0.0013)	(0.0058)	(0.010)	(0.0070)
20k edge in 100m	0.024	-0.0045	-0.012	-0.030	0.013
	(0.043)	(0.0023)	(0.0096)	(0.016)	(0.011)

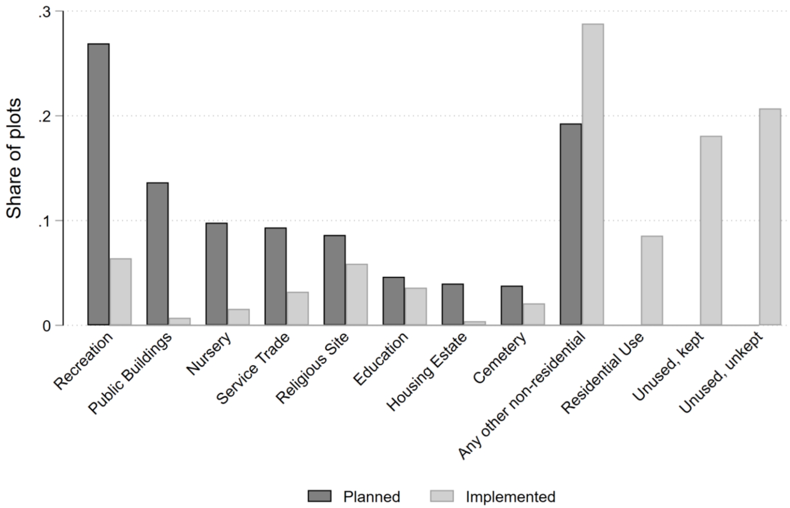
Amenities part II: planned non-residential ignored

	(1) Ln Price	(2) Share gridcell built	(3) Plot is built	(4) Log area of buildings	(5) Multiple buildings on plot
Pln. recreation in 100m	-0.012	-0.00094	-0.0088	-0.011	-0.0065
	(0.040)	(0.0019)	(0.0071)	(0.012)	(0.0089)
Pln. nursery school in 100m	0.071	0.0061	0.017	0.029	0.0049
	(0.043)	(0.0026)	(0.0097)	(0.017)	(0.013)
Pln. religious site in 100m	0.037	0.0020	0.016	-0.0075	-0.0076
	(0.055)	(0.0030)	(0.012)	(0.020)	(0.015)
Pln. education in 100m	0.15	-0.0049	-0.0090	-0.026	-0.0027
	(0.074)	(0.0030)	(0.011)	(0.021)	(0.014)
Pln. service trade in 100m	-0.058	-0.0014	-0.0031	-0.0051	-0.011
	(0.092)	(0.0043)	(0.016)	(0.030)	(0.021)
Pln. housing estate in 100m	-0.13	0.0016	0.0097	0.0092	-0.036
	(0.098)	(0.0075)	(0.031)	(0.048)	(0.033)
Pln. public building in 100m	-0.0042	-0.0053	-0.010	-0.043	-0.028
	(0.085)	(0.0044)	(0.016)	(0.029)	(0.020)
Pln. cemetery in 100m	0.044	0.0042	0.038	-0.046	0.0025
	(0.13)	(0.0051)	(0.019)	(0.034)	(0.023)
Pln. any other non-res in 100m	0.14	-0.0025	-0.021	0.0053	0.022
	(0.073)	(0.0031)	(0.012)	(0.023)	(0.015)
Mean Outcome	17	0.11	0.49	5.3	0.38
N (gridcells)	4074	94789	94789	46465	46465
N (plots)	1446	36215	36215	17822	17822

Implementation rates for non-res amenities are low

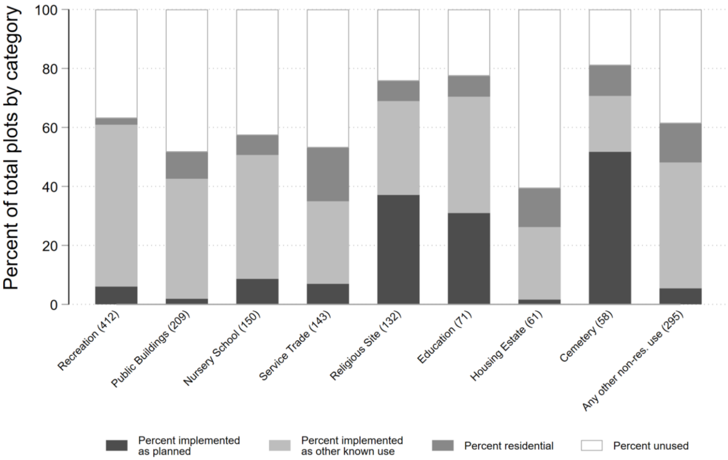


Implementation rates for non-res amenities are low



Note: implemented not always where planned. Main unplanned uses: farming and residential

Implementation rates vary by planned use



When non-res implementation does happen, locations mostly follow plan

For non-res plots with known use and implementation, calculate:

P(implemented as use j | planned as use j)/P(implemented as use j)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Observed	Perfect	Random Implementation			N Plots	
	Ratio	Ratio	Median	95-pct	99-pct	Plan	Impl.
recreation	2.9	3.4	.99	1.2	1.3	411	96
nursery school	5.6	9.4	.86	2.1	2.6	148	22
religious	6.1	11	.99	1.6	1.9	131	86
education	10	20	.77	1.9	2.7	71	51
service trade	2.6	9.8	.87	1.7	2.2	143	45
housing estate	11	23	0	11	11	61	2
public buildings	2.7	6.7	.67	2	2.7	209	10
cemetery	24	24	.79	2.4	3.2	57	31
Weighted average	5.3	10	.96	1.5	1.8	.	.
Total	.	.	.	.	.	1,231	343

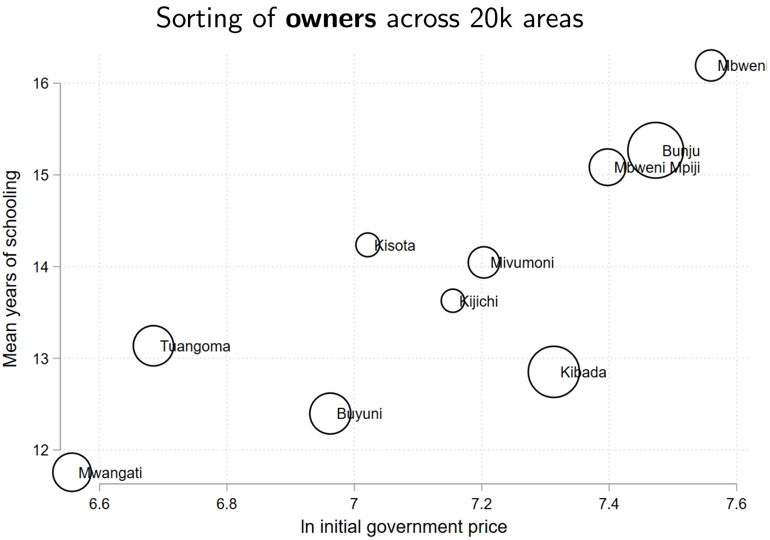
Implemented non-residential amenities positively correlated with housing, while unused-unkept negatively correlated

	(1) Share gridcell built	(2) Plot is built	(3) Log area of buildings	(4) Multiple buildings on plot
Impl. farming in 100m	-0.00023	0.0067	-0.011	-0.0034
	(0.0023)	(0.0087)	(0.015)	(0.010)
Impl. recreation in 100m	0.0064	0.0024	0.033	0.0043
	(0.0031)	(0.011)	(0.019)	(0.013)
Impl. religious site in 100m	0.011	0.029	0.013	0.013
	(0.0043)	(0.016)	(0.027)	(0.018)
Impl. education in 100m	0.000043	0.0016	-0.027	-0.0015
	(0.0044)	(0.015)	(0.027)	(0.017)
Impl. cemetery in 100m	0.0028	0.021	-0.021	0.031
	(0.0054)	(0.018)	(0.034)	(0.024)
Impl. service trade in 100m	0.016	0.050	0.052	0.057
	(0.0053)	(0.019)	(0.029)	(0.023)
Impl. nursery school in 100m	0.0072	0.037	0.0016	0.019
	(0.0072)	(0.028)	(0.039)	(0.026)
Impl. other non-res in 100m	-0.0052	-0.033	0.0054	0.0086
	(0.0076)	(0.025)	(0.042)	(0.025)
Impl. public building in 100m	-0.0062	-0.034	-0.013	0.083
	(0.010)	(0.040)	(0.060)	(0.045)
Impl. housing estate in 100m	0.051	0.20	0.17	0.19
	(0.011)	(0.062)	(0.094)	(0.099)
Impl. unknown non-res in 100m	-0.0017	0.13	-0.14	-0.26
	(0.060)	(0.22)	(0.041)	(0.058)
Unused, kept in 100m	0.0032	0.00017	-0.021	-0.0022
	(0.0026)	(0.010)	(0.016)	(0.012)
Unused, unkept in 100m	-0.0084	-0.035	-0.042	-0.023
	(0.0027)	(0.010)	(0.017)	(0.012)
Impl. as residential in 100m	-0.0034	-0.0017	-0.013	-0.0049
	(0.0033)	(0.014)	(0.023)	(0.017)
Mean Outcome	0.11	0.49	5.3	0.38
N (gridcells)	94789	94789	46465	46465
N (plots)	36215	36215	17822	17822

Sorting (mean years of schooling) **into 20k areas**

- We measure sorting by mean years of schooling
- Strong sorting into 20k ownership
  - Heads of households in Dar es Salaam as a whole: 8.7 years (LSMS Dar es Salaam 2014)
  - Heads of households in 20k: 11.5 years (our survey)
    - N=3230, median=11 years
  - About half are owners: 13.8 years (our survey)
    - N=1662, median=16 years
  - Other half non-owners (our survey): 9.1 years

Sorting of owners by mean years of schooling **across 20k areas**



Sorting of owners by years of schooling **within 20k areas**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln plot size	1.27			1.26	0.93			0.92
	(0.35)			(0.35)	(0.33)			(0.33)
Ln property value estimate		1.36				1.19		
		(0.17)				(0.18)		
Ln price			1.15				0.73	
			(0.23)				(0.27)	
Dist (km) paved major road				0.08				0.63
				(0.14)				(0.19)
Mean Outcome	14	14	14	14	14	14	14	14
Period*Source FE			✓				✓	
20K*Mtaa FE					✓	✓	✓	✓
N (gridcells)	5019	4086	1027	5019	5018	4085	1027	5018
N (plots)	1649	1352	339	1649	1648	1351	339	1648

Settlement dates of owners within 20k areas - as in model

	(1) Year Building Occupied	(2) Year Building Occupied	(3) Year Construction Started	(4) Year Construction Started
Ln plot size	-0.71	-0.91	-0.55	-0.69
	(0.43)	(0.43)	(0.38)	(0.39)
Years of schooling		0.24		0.14
		(0.037)		(0.036)
Dist (km) paved major road	0.83	0.68	0.64	0.59
	(0.29)	(0.28)	(0.29)	(0.28)
Mean Outcome	2,014	2,014	2,010	2,010
N (gridcells)	4907	4893	4237	4230
N (plots)	1611	1606	1383	1381

Conclusions (∼10-20 years after project implementation)

1. Descriptive: the plots sold, covered project cost (∼1 USD 2021 per sqm)
   - Bare land values increased and are now double those in nearby unplanned areas
   - But only half of ∼36k residential plots currently built
2. **Focusing on within-project variation:**
   - Plot layout:
     - Relatively too few small plots were supplied (price elasticity of plot size around -0.5; larger plots have more open space and about 1/3 population density)
     - Regular plot layout & proximity to similarly small plots spur plot development
   - Amenities:
     - Proximity to main paved roads is prized (higher land values and plot development)
     - Natural amenities (higher elevation, low ruggedness, distance from water) are valued
     - Proximity to planned non-residential amenities is *not* valued (low implementation)
3. The owners, especially of large plots, are highly educated (poor mostly excluded)

Suggestions for improving ‘de novo’ planning, based on our findings from this specific context

1. Ensure that property rights are secure
2. Make neighborhoods physically accessible both locally and globally
3. Make plot allocation process more transparent and less rushed
4. Allow for relatively more small plots
5. Focus the planning on formal plots and roads rather than on other amenities
6. Where possible, make plot layout regular
7. Allow for the fact that physical hazards influence buildup rate

Thank you!

- Feedback very welcome after the talk or over email
- Guy Michaels (G.Michaels@lse.ac.uk)

Plot acquisition process for a prospective buyer back

1. Collect application forms from municipality or Ministry of Lands
2. Submit completed form to municipal land office
3. Receive confirmation of successful application:
   - Priority given to those who: had owned land in this specific area, could pay for plot type, and met gender and disability criteria.
4. Collect acceptance form and start making the payment within 14 days
   - Failure to complete the payment and finalize the transaction within 60 days resulted in reallocation of plot to another potential buyer

Standard error estimation back

- Cluster by insulae - the main units of plot size assignment (Abadie et al. QJE 2023)
  - Insulae fixed effects have high r-squared in explaining variation in plot size assignment, though there is a bit of variation in plot size within insulae
  - There is also a bit of correlation between insulae
- Results broadly similar when clustering on:
  - (Smaller) plot identifiers
  - (Larger)
    - Interactions of program areas with enumeration areas in the 2012 census
    - mitaa (34 local administrative units)
    - The 12 project areas